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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference 726117	FOR FURTHER ACTION	See Form PCT/IPEA/416
International application No. PCT/AU2004/001096	International filing date *(day/month/year)* 16 August 2004	Priority date *(day/month/year)* 15 August 2003
International Patent Classification (IPC) or national classification and IPC Int. Cl. [7] B22D 17/04, 35/04		
Applicant COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION et al		

1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 3 sheets, including this cover sheet..
3. This report is also accompanied by ANNEXES, comprising:
   a. [X] *(sent to the applicant and to the International Bureau)* a total of 7 sheets, as follows:
      - [X] sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions).
      - [ ] sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box.

   b. [ ] *(sent to the International Bureau only)* a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or table related thereto, in computer readable form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).
4. This report contains indications relating to the following items:
   - [X] Box No. I Basis of the report
   - [ ] Box No. II Priority
   - [ ] Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - [ ] Box No. IV Lack of unity of invention
   - [X] Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - [ ] Box No. VI Certain documents cited
   - [ ] Box No. VII Certain defects in the international application
   - [ ] Box No. VIII Certain observations on the international application

Date of submission of the demand 15 June 2005	Date of completion of the report 7 July 2005
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer A Davies Telephone No. (02) 6283 2072

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International application No.
PCT/AU2004/001096

Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ This report is based on translations from the original language into the following language which is the language of a translation furnished for the purposes of:

☐ international search (under Rules 12.3 and 23.1 (b))

☐ publication of the international application (under Rule 12.4)

☐ international preliminary examination (under Rules 55.2 and/or 55.3)

2. With regard to the **elements** of the international application, this report is based on (*replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report*):

☐ the international application as originally filed/furnished

☒ the description:

pages **1,2,4-30** as originally filed/furnished
pages* **3, 3a** received by this Authority on **15 June 2005** with the letter of **15 June 2005**
pages* received by this Authority on with the letter of

☒ the claims:

pages as originally filed/furnished
pages* as amended (together with any statement) under Article 19
pages* **31-35** received by this Authority on **15 June 2005** with the letter of **15 June 2005**
pages* received by this Authority on with the letter of

☒ the drawings:

pages **1-7** as originally filed/furnished
pages* received by this Authority on with the letter of
pages* received by this Authority on with the letter of

☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing.

3. ☐ The amendments have resulted in the cancellation of:

☐ the description, pages
☐ the claims, Nos.
☐ the drawings, sheets/figs
☐ the sequence listing (*specify*):
☐ any table(s) related to the sequence listing (*specify*):

4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).

☐ the description, pages
☐ the claims, Nos.
☐ the drawings, sheets/figs
☐ the sequence listing (*specify*):
☐ any table(s) related to the sequence listing (*specify*):

* *If item 4 applies, some or all of those sheets may be marked "superseded."*

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

International application No.
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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims 1-24	YES
	Claims	NO
Inventive step (IS)	Claims 1-24	YES
	Claims	NO
Industrial applicability (IA)	Claims 1-24	YES
	Claims	NO

2. Citations and explanations (Rule 70.7)

WO, 1999/028065, A1 (COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANISATION) 10 June 1999

WO, 2001/019552, A1 (HOTFLO DIECASTING PTY LTD) 22 March 2001

The amended claims define the flow-path exit module as having a a transverse cross-sectional area which increases in a direction extending beyond the outlet of the runner such that the resulting decrease in velocity is able to preclude a change of state of the alloy from a molten state to a semi-solid state exhibiting thixotropic properties.

This is not disclosed nor fairly suggested by the citations. The amended claims are hence considered to be novel and inventive.

the alloy flow velocity is at a level significantly below the level at the outlet end of the runner and such that, on filling of the die cavity, the alloy is able to undergo solidification in the die cavity and back along the flow path towards the runner; and

wherein said form is such that the FEM increases in transverse cross-sectional area in a direction extending beyond the outlet end of the runner, whereby the decrease in alloy flow velocity is able to preclude a change of state of the alloy from a molten state to a semi-solid state exhibiting thixotropic properties.

Additionally, the invention provides a pressure casting machine for high pressure die casting of alloys, wherein the machine has, or operable to provide, a pressurised source of molten alloy, a mould defining at least one die cavity, and a metal flow device which defines a metal flow path by which alloy received from the pressurised source is able to flow into the die cavity, wherein:

(a) a first part of the length of the flow path includes or comprises a runner; and

(b) a second part of the length of the flow path from an outlet end of the runner includes a flow-path exit module (FEM); and

wherein the FEM has a form which controls the alloy flow whereby the alloy flow velocity decreases progressively from the level at the outlet end of the runner whereby, at a location at which the flow path communicates with the die cavity, the alloy flow velocity is at a level significantly below the level at the outlet end of the runner and such that, on filling of the die cavity, the alloy is able to undergo solidification in the die cavity and back along the flow path towards the runner; and

wherein said form is such that the FEM increases in transverse cross-sectional area in a direction extending beyond the outlet end of the runner, whereby the decrease in alloy flow velocity is able to preclude a change of state of the alloy from a molten state to a semi-solid state exhibiting thixotropic properties

The invention also provides a method of producing alloy castings using a high pressure die casting machine having, or operable to provide, a pressurised source of molten alloy and a mould defining at least one die cavity, in which the alloy flows from the source to the die cavity along a flow path, wherein:

(a) the alloy, in a first part of the flow path, is caused to flow along a runner; and

(b) in a second part of the flow path, between the first part and the die cavity, the alloy flow is controlled whereby the flow velocity progressively decreases from the level at an outlet end of the runner to a flow velocity where the flow path communicates with the die cavity which is at a level significantly below the level at the outlet of the runner; and

wherein said control is such that, in the FEM, the alloy flow is increased in transverse cross-sectional area in a direction extending beyond the outlet end of the runner, whereby the decrease in alloy flow velocity precludes a change of state of the alloy from a molten state to a semi-solid state exhibiting thixotropic properties.

As indicated, the second part of the flow path decreases the alloy flow velocity below the flow velocity level at the outlet end of the runner. The second

CLAIMS

1. A metal flow device for high pressure die casting of alloys, using a machine having, or operable to provide, a pressurised source of molten alloy and a mould defining at least one die cavity, wherein the device defines a metal flow path by which alloy received from the pressurised source is able to flow into the die cavity, wherein:

(a) a first part of the length of the flow path includes or comprises a runner; and

(b) a second part of the length of the flow path from an outlet end of the runner includes a flow-path exit module (FEM); and

wherein the FEM has a form which controls the alloy flow whereby the alloy flow velocity decreases progressively from the level at the outlet end of the runner whereby, at a location at which the flow path communicates with the die cavity, the alloy flow velocity is at a level significantly below the level at the outlet end of the runner and such that, on filling of the die cavity, the alloy is able to undergo solidification in the die cavity and back along the flow path towards the runner; and wherein said form is such that the FEM increases in transverse cross-sectional area in a direction extending beyond the outlet end of the runner, whereby the decrease in alloy flow velocity is able to preclude a change of state of the alloy from a molten state to a semi-solid state exhibiting thixotropic properties.

2. The device of claim 1, wherein the runner has a cross-sectional area at least at its outlet end such that, at an alloy mass flow rate able to be generated by the machine, the runner will result in an alloy flow velocity at the outlet end of the runner in excess of about 60 m/s up to about 180 m/s for a magnesium alloy and in excess of about 40 m/s up to about 120 m/s for alloys other than magnesium alloys.

3. The device of claim 1 or claim 2, wherein the increase in cross-sectional area is such that the decrease in the flow velocity is able to prevent the alloy from undergoing a change of state to enable die cavity fill by molten alloy.

4. The device of claim 1 or claim 2, wherein the increase in cross-sectional area is such that said alloy is able to attain a solids content of less than 25 wt%.

5. The device of claim 1 or claim 2, wherein the increase in cross-sectional area is such said alloy is able to attain a solids content of less than about 20 or 22 wt%.

6. The device of claim 1 or claim 2, wherein the increase in cross-sectional area is such that said alloy is able to attain a solids content of less than about 17 wt%.

7. The device of any one of claims 1 to 6, wherein a gate is defined at the outlet end of the flow path which provides a constriction to alloy flow therethrough.

8. The device of any one of claims 1 to 6, wherein a gate is defined at the outlet end of the flow path which is not a constriction to alloy flow therethrough.

9. The device of claim 7 or claim 8, wherein the gate is at the outlet end of the FEM.

10. The device of claim 7 or claim 8, wherein the outlet end of the FEM is spaced from the gate by a secondary runner which has a cross-sectional area at least equal to the cross-sectional area at the outlet end of the FEM.

11. A pressure casting machine for high pressure die casting of alloys, wherein the machine has, or operable to provide, a pressurised source of molten alloy, a mould defining at least one die cavity, and a metal flow device which defines a metal flow path by which alloy received from the pressurised source is able to flow into the die cavity, wherein:

(a) a first part of the length of the flow path includes or comprises a runner; and

(b) a second part of the length of the flow path from an outlet end of the runner includes a flow-path exit module (FEM); and

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wherein the FEM has a form which controls the alloy flow whereby the alloy flow velocity decreases progressively from the level at the outlet end of the runner whereby, at a location at which the flow path communicates with the die cavity, the alloy flow velocity is at a level significantly below the level at the outlet end of the runner and such that, on filling of the die cavity, the alloy is able to undergo solidification in the die cavity and back along the flow path towards the runner; and

wherein said form is such that the FEM increases in transverse cross-sectional area in a direction extending beyond the outlet end of the runner, whereby the decrease in alloy flow velocity is able to preclude a change of state of the alloy from a molten state to a semi-solid state exhibiting thixotropic properties

12. The machine of claim 11, wherein the runner has a cross-sectional area at least at its outlet end such that, at an alloy mass flow rate able to be generated by the machine, the runner will result in an alloy flow velocity at the outlet end of the runner in excess of about 60 m/s up to about 180 m/s for a magnesium alloy and in excess of about 40 m/s up to about 120 m/s for alloys other than magnesium alloys.

13. The machine of claim 11 or claim 12, wherein the increase in cross-sectional area is such that the decrease in the flow velocity is able to prevent the alloy from undergoing a change of state to enable die cavity fill by molten alloy.

14. The machine of claim 11 or claim 12, wherein the increase in cross-sectional area is such that said alloy is able to attain a solids content of less than 25 wt%.

15. The machine of claim 11 or claim 12, wherein the increase in cross-sectional area is such said alloy is able to attain a solids content of less than about 20 or 22 wt%.

16. The machine of claim 11 or claim 12, wherein the increase in cross-sectional area is such that said alloy is able to attain a solids content of less than about 17 wt%.

17. A method of producing alloy castings using a high pressure die casting machine having a pressurised source of molten alloy and a mould defining at least one die cavity, in which the alloy flows from the source to the die cavity along a flow path, wherein:

(a) the alloy, in a first part of the flow path, is caused to flow along a runner; and

(b) in a second part of the flow path between the first part and the die cavity and comprising a flow-path exit module (FEM), the alloy flow is controlled whereby the flow velocity progressively decreases from the level at an outlet end of the runner to a flow velocity whereby the flow path communicates with the die cavity which is at a level significantly below the level at the outlet of the runner; and

wherein said control is such that, in the FEM, the alloy flow is increased in transverse cross-sectional area in a direction extending beyond the outlet end of the runner, whereby the decrease in alloy flow velocity precludes a change of state of the alloy from a molten state to a semi-solid state exhibiting thixotropic properties.

18. The method of claim 17, wherein the runner is provided with a cross-sectional area at least at its outlet end such that, at an alloy mass flow rate able to be generated by the machine, an alloy flow velocity at the outlet end of the runner is in excess of about 60 m/s up to about 180 m/s for a magnesium alloy and in excess of about 40 m/s up to about 120 m/s for alloys other than magnesium alloys.

19. The method of claim 17 or claim 18, wherein the increase in cross-sectional area is such that the decrease in the flow velocity prevents the alloy from undergoing a change of state and die cavity fill is by molten alloy.

20. The method of claim 17 or claim 18, wherein the increase in cross-sectional area is such that said alloy attains a solids content of less than 25 wt%.

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21. The method of claim 17 or claim 18, wherein the increase in cross-sectional area is such that said alloy attains a solids content of less than about 20 or 22 wt%.

22. The method of claim 17 or claim 18, wherein the increase in cross-sectional area is such that said alloy attains a solids content of less than about 17 wt%.

23. The method of any one of claims 17 to 22, wherein alloy flow is constricted by a gate defined at the outlet end of the flow path.

24. The method of any one of claims 17 to 22, wherein alloy flow is not constricted by a gate defined at the outlet end of the flow path.